# THE DENTAL PRACTITIONER

## AND DENTAL RECORD

*Including the Transactions of the British Society for the Study of Orthodontics, and the official reports of the British Society of Periodontology, the Glasgow Odontological Society, the Liverpool and District Odontological Society, the North Staffordshire Society of Dental Surgeons, the Odonto-chirurgical Society of Scotland, and the Dental and Medical Society for the Study of Hypnosis*




VOL. XI, No. 6 February, 1961

Monthly 3s. 6d. post 5d. JOHN WRIGHT & SONS LTD. BATH ROAD, BRISTOL 4 Annually £2 2s. post free

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*Vol.* XI, *No.* 6 — *February*, 1961

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THE DENTAL PRACTITIONER
AND DENTAL RECORD

Vol. XI, No. 6 February, 1961

*EDITORIAL*

# PROSTHETICS IN PRACTICE AND THEORY

WITH the ever-increasing longevity of people through the successful fight against disease by our medical confrères and the continuing failure on our part to stem the loss of teeth through dental caries and periodontal disease, the need for artificial dental appliances will become more and more necessary for greater numbers of the population.

Though the provision of artificial dentures is one of the oldest and most practised parts of the dental procedures, it also remains one of the most difficult to achieve satisfactorily. The thoughtful practitioner is not surprised at this when he considers some of the following problems.

First, the concealment of the denture means the provision of tooth form which is appropriate to the patient's age. Unfortunately patients in general prefer a denture that will belie their age rather than conform to it.

Secondly, the denture is likely to retain its true fit for only a short time by reason of the almost inevitable disappearance of the ridges. This is not accepted as it should be, either by the patients or by many general practitioners.

Thirdly, there are the vast numbers of variables that affect the construction and wearing of a denture.

Possibly the most vexing problems of all are to be found in the maxillo-mandibular relationship and the mandibular movements. An enormous amount of research and theorizing is being devoted to the subject, estimable from the large numbers of papers appearing in the dental journals of the world. There would also seem to be considerable conflict of ideas about the position of the mandible and how it moves.

As Dr. Carl Boucher, editor of the *Journal of Prosthetics*, says: "Probably if personal preferences and prejudices were eliminated there is not as much disagreement as appears on the surface. The disturbing factor is one of viewpoint. To trust the results of a single experimental method as a basis of one's beliefs is unsound and can lead to erroneous conclusions. The solution of the problem will become simple and the true picture of mandibular position and movement will become clear when we are able to assemble all the information obtained by all experimental methods and analyse all of the data in their true perspective. We have not yet arrived at this point in our development."

In this issue of the DENTAL PRACTITIONER Francis Fish clarifies and analyses some of the past research work and makes suggestions concerning the understanding of the phenomenon of the relative constancy of the rest position of the mandible.

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BOUCHER, C. O. (1960), *J. prosth. Dent.* **10**, 411.

# THE FUNCTIONAL ANATOMY OF THE REST POSITION OF THE MANDIBLE

By FRANCIS FISH, F.D.S.
*Department of Prosthetics, The London Hospital Dental School*

THE observations to be presented concern edentulous patients, each of whom was in possession, and accustomed to the use, of full upper and lower dentures. The object of the investigation was to see if evidence could be obtained to test a particular hypothesis, namely, that the rest position of the mandible is related to the posture of the tongue in its respiratory function as part of the anterior wall of the pharynx. This hypothesis is based upon the facts (1) that the mandible is part of the suspensory mechanism of the tongue, (2) that the posterior part of the tongue has as one of its functions that of completing the anterior wall of the pharynx, and (3) that it is active in this function when the mandible is in what the dentist calls the rest position.

A number of patients chosen at random were examined radiographically with the aid of the cephalostat. Two exposures were made in rapid succession, without the patient leaving the cephalostat. The first was of the patient in the rest position with the dentures in place, the second in the rest position with the dentures removed. Before introduction to the cephalostat each patient was rehearsed in the assumption of the rest position while seated in the normal upright posture. In using the cephalostat, care was taken to ensure that the relative positions of seat and head frame were such as to permit the upright posture and the patient was carefully observed to ensure that relaxation was achieved before the film was exposed. The films were superimposed, and observations recorded of any changes in the position of mandible, soft palate, tongue, and hyoid bone. An estimate was made in each case of the degree of alveolar resorption.

It was considered that this technique would simulate the consequences of the loss of the teeth and the alveolar processes and would permit reliable observations of these consequences by eliminating uncertainties arising from comparison of films of this type taken on different occasions, as, for instance, before and after extraction of the natural teeth.

*Figs.* 1–4 are reproductions of the radiographs taken with the dentures removed. The dotted outlines have been traced from the radiographs taken in the rest position with the dentures in place.

The diagram in *Fig.* 5 is a conspectus of the changes observed with the patients in the rest position with the dentures removed as compared with the rest position with the dentures in place.

Each vertical column contains the data for one patient, identified by the initials at the top. The data recorded are the changes observed in the position of various structures on removal of the dentures. The structures are named, and the nature of the change described, on the left of the diagram. A blank outline indicates that no change was observable. A blocked-in area corresponds to observable change, in the sense shown on the left, the size of the area being approximately proportional to the dimensions of the change, one small square representing 1 mm. The number of crosses at the foot of each column is proportional to the degree of resorption. Patients W.S. to R.B. comprise the first group mentioned below, R.H. to H.D. the second, and W.R. to S.E. the third group.

It can be seen that the patients can be separated into two principal groups and one minor group. In the first group the characteristic feature is that no change takes place in the position of the mandible on withdrawal of the dentures, and the rest position of the mandible appears to be the same whether the dentures are in place or not. Of this group, 7 appear in the present series and the diagram shows that 6 members of this group have common tendencies in other respects also, i.e., the soft palate is protracted, the pharyngeal part of the tongue is protracted, and the degree of alveolar resorption is small. In the second major group the removal of the dentures brings

*Fig.* 1.—Radiograph showing rest position with dentures removed; mandible unchanged; soft palate and pharyngeal part of tongue protracted; hyoid and dorsum of tongue raised; tip of tongue raised and retracted. Resorption moderate. In this and all succeeding radiographs the dotted outlines have been traced from a similar radiograph taken with the dentures in place.

*Fig.* 2.—Radiograph showing rest position with dentures removed; mandible raised; soft palate and pharyngeal part of tongue protracted; hyoid unchanged; dorsum and tip of tongue lowered. Resorption moderate.

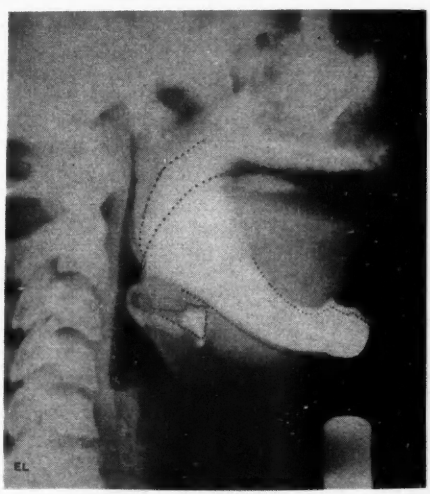

*Fig.* 3.—Radiograph showing rest position with dentures removed; mandible raised; soft palate and pharyngeal part of tongue unchanged; hyoid lowered; dorsum and tip of tongue lowered. Resorption severe.

*Fig.* 4.—Radiograph showing rest position with dentures removed; mandible lowered; soft palate and pharyngeal part of tongue unchanged; dorsum and tip of tongue lowered. Resorption slight.

about a rest position in which the mandible is raised, and in 5 of the 8 patients in this group no change can be seen in the position of the soft palate or in the pharyngeal part of the tongue, while in a sixth patient the changes

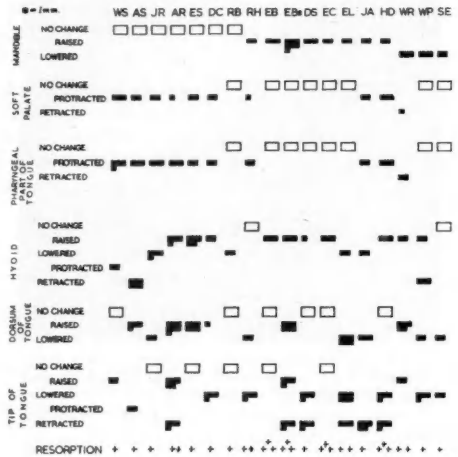


*Fig.* 5.—Diagrammatic conspectus of observations. For each patient, identified by the initials at the top of the diagram, the relation between the position of the various structures in the rest position with the dentures removed and that with the dentures in place is denoted as follows: No change on withdrawal of dentures—A blank outline; Change in the sense shown on the left—A blocked-in area of which the size is proportional to the dimension of the change, one small square unit representing 1 mm. Degree of resorption indicated by number of crosses.

in these structures are small. In this group are found those patients in whom the degree of alveolar resorption is moderate or excessive.

If the above findings are considered together with the fact that removal of the teeth is followed by the spreading of the oral part of the tongue, it is suggested that they can be related in the following way: When the volume of the dentures is small, as when resorption has not been excessive, compensation for the increase in the proportion of the bulk of the tongue that is present in the oral cavity is brought about by a protraction of the pharyngeal part of the tongue and the soft palate, the respiratory seal being maintained at a slightly more anterior site than before. When the alteration is large, as when the removal of the dentures represents the removal of a large volume of tissue from the oral cavity, the necessary adjustment cannot be brought about by the tongue, for in doing so the performance of its respiratory function would be prejudiced and, instead, the volume of the oral cavity is itself reduced by raising the mandible. This limited investigation would thus appear to confirm the hypothesis that the rest position of the mandible is related to the respiratory function of the tongue, and that the teeth enter into the establishment of the rest position, not directly as teeth, but indirectly as elements occupying space in the oral cavity.

## DISCUSSION OF LITERATURE

The rest position of the mandible is an identifiable, though imprecise, relationship to which reference is made as a basic datum in many procedures in clinical dentistry. Eastwood (1952) describes the value of the rest position of the mandible for assessment of the nature and degree of disorders of the arch relationship; Schweitzer (1951) considers that it is the rest position that gives the clue to the correct lateral and anteroposterior relationship between the mandible and the skull; Craddock (1956), Fenn, Liddelow, and Gimson (1953), Lammie (1956), and many other writers on prosthetic dentistry, regard the rest position as of fundamental importance in determining the intermaxillary relationship for the purpose of designing full dentures.

The value of this relationship is its apparent independence of the teeth, and early publications (Niswonger, 1934; Thompson, 1946) describe this independence as being absolute. More recently (Tallgren, 1957; Atwood, 1956, 1957, 1958) evidence has been published that removal of the teeth is followed, in a high proportion of patients, by a change in the rest position. The sense of this change is usually as would be expected, i.e., the mandible takes up a position nearer to the maxilla, but the dimension of the change is comparable with the dimension of the lost teeth only in patients who have been without natural teeth for many years (Tallgren).

The nature of the changes in the rest position is of more than dialectic interest if this relationship is to be used as a datum as described above. In this respect, the interests of orthodontist, prosthetist, and specialist in disorders of the temporomandibular joint are identical. It is clear, also, that this significance of the rest position is inadequately recognized by its being so named, the name having reference to the fact that it is the position of the mandible when neither speech nor mastication is going on.

A further attribute of this position is expressed in the statement that "all masticatory movements start and finish in the rest position" (Kazis and Kazis, 1956). This phrase recalls Sherrington's comment (1920) that "posture is the basis of all movement and all movement begins and ends in posture", and suggests that the nature of the control of the rest position is similar to that of other postural phenomena. Best and Taylor (1955) in fact classify the jaw muscles as members of the antigravity group. Ballard (1955) reported important evidence on this point in that he was able to identify a mandibular postural reflex in newborn babies, and this work is confirmed by that of Moyers (1956). Gesell and Amatruda (1945) reported swallowing movements and "spasmodic respiratory movements of chest and abdomen" observed in the sixteenth week of fœtal life, a finding which establishes the early stage in growth at which these basic muscular patterns appear.

It appears that the consensus is that the rest position has the qualities of a postural relationship, and Brill, Lammie, Osborn, and Perry (1959) have published a detailed account of the nerve pathways and connexions that transmit the controlling impulses. There is, however, no similar agreement on the nature of the factors that are responsible for the establishment of the rest position for a particular individual at one level rather than another. Many of the descriptions of the rest position are expressed in terms of the resting length of the muscles of mastication or in terms of the balance of the muscles attached to the mandible (Grewcock and Ballard, 1954; Lammie, 1956). Last (1955) criticized the first of these concepts on the ground that the rest position of the mandible varies for a particular individual with variations on physiological state, but his alternative suggestion, that the potential volume of temporomandibular joint space is the controlling factor, is open to the same objections.

The defect of the explanation by muscle balance is that it is not specific, for the maintenance of any bone in any position demands a condition of balance in the operating muscles and the use of the term "tonus" to describe the balancing muscle activity is merely another way of saying that the bony relationship is habitual and postural, reflexly controlled. The further stipulation that the condyles shall be in their most posterior functional position in the glenoid fossæ adds little to precise definition, for Posselt (1952) has shown that this location of the condyles can be maintained through an opening of up to 2 cm. separation at the incisors.

Nor does it appear that the techniques of electromyography give any aid, for the published work has not so far included any set of recordings that permit the association of any particular picture of muscle activity with the rest position. For instance, Jarabak (1957), basing his comment upon his own work and that of Gellhorn (1953) wrote: "we may deduce that the electromyograph, sensitive as it is, is not sensitive enough to record motor activity from very slow marginal movements on either side of the rest position". From this it seems reasonable to make a further deduction that the condition of electrical silence, which has been claimed as the characteristic of the rest position, may not always be distinguishable from instrumental artefact. In the same paper Jarabak publishes electromyograph tracings which show definite activity in the anterior part of the temporalis muscle with the mandible in the rest position.

## RECOGNITION OF FUNCTIONAL TERMS

It would, in fact, be preferable if the rest position could be defined in terms which relegate anatomical structures to a secondary role, and, instead, place the emphasis upon some functional relationship, for, as Sir Arthur Keith wrote, "it comes to this, that

function plays to a muscle the part that embankments do to a stream, or the part that a string does to a climbing tendril, or the part that rails do to an engine". From the dental point of view, the only observable consequence of this posture is that the teeth are separated

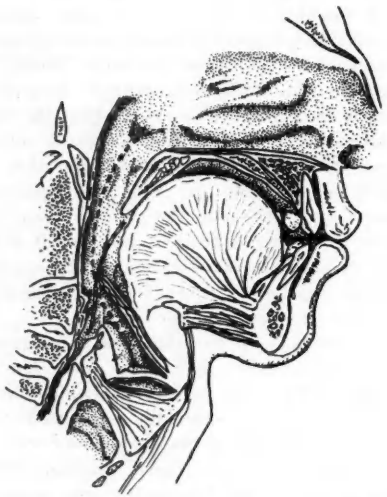

*Fig.* 6.—Sagittal section, based upon a radiograph of subject in rest position, detail taken from a dissection. The markers show the cross-over of the respiratory and alimentary pathways in the pharynx.

by the interocclusal clearance and there is no convincing evidence that this separation determines the rest position. On the other hand, if the mandible is considered from the point of view of its functions other than the dental ones, it is obvious that it takes an essential part in activities very much more fundamental than supporting the teeth. In the first place, via its ligaments and the muscles of mastication, it is part of the uppermost suspension of the cervical portions of the alimentary and respiratory tracts, sharing this function with such structures as the stylohyoid, stylo-pharyngeus, salpingo-pharyngeus, palatoglossus, and palato-pharyngeus muscles. Further, it is part of the support for the lips, which provide the sphincter mechanism at the entrance to the alimentary canal, and for the cheeks, which form the first segment of that canal. It also forms an element in the structural complex that gives attachment to the muscles controlling the crossover of the respiratory and alimentary pathways that takes place in the oropharynx (*Fig.* 6). The mandible takes part directly in this complex by virtue of its providing the anterior attachment of the tongue (*Fig.* 7), for not only is the tongue the organ for speech and for the

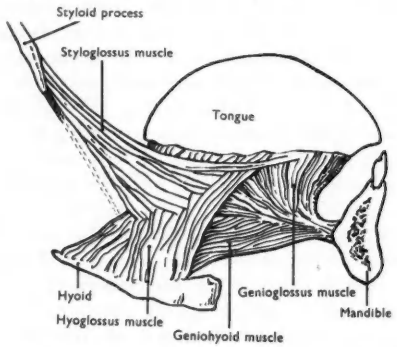


*Fig.* 7.—To show the suspension of the tongue. (Redrawn from *A Method of Anatomy* (*Grant, J. C. B.*). *6th Ed.*, 1958, *by courtesy of The Williams & Wilkins Co.*)

manipulation of food in the oral cavity, it is also part of the anterior wall of the pharynx, *Fig.* 7 showing how the surface of the tongue is distributed between mouth and pharynx. Further, in addition to the direct support mentioned above, the mandible participates indirectly in the support of the tongue via the hyoid bone by means of the geniohyoid and mylohyoid muscles (*Fig.* 8). The importance of these attachments becomes obvious when they are severed, as by a gunshot wound, when the immediate life-saving measure is to secure the tongue against falling back and occluding the airway. The attachment of the hyoid bone to the mandible extends this complex still further, for the hyoid bone is part of the suspensory mechanism of the larynx and the upper part of the pharyngeal tube finds attachment to larynx, hyoid, tongue, and mandible via the constrictors.

Thus the anatomical relationships express the functional necessity that the movements

of the larynx shall be co-ordinated with the activity of the pharynx. Negus (1943) described how, in the act of swallowing, the larynx rises into apposition with the base of the tongue. The cinéradiographic method of Ardran and Kemp (1951) enabled them to describe in detail the activity of the tongue as it ejects the bolus into the pharynx, co-operates with the superior constrictor in thrusting the bolus downward, and arches backward into the pharynx as the bolus descends. As the slope of the tongue increases hyoid and thyroid rise, the entroit of the larynx constricts and it inclines backward, and the epiglottis executes a very rapid dip-and-rise movement.

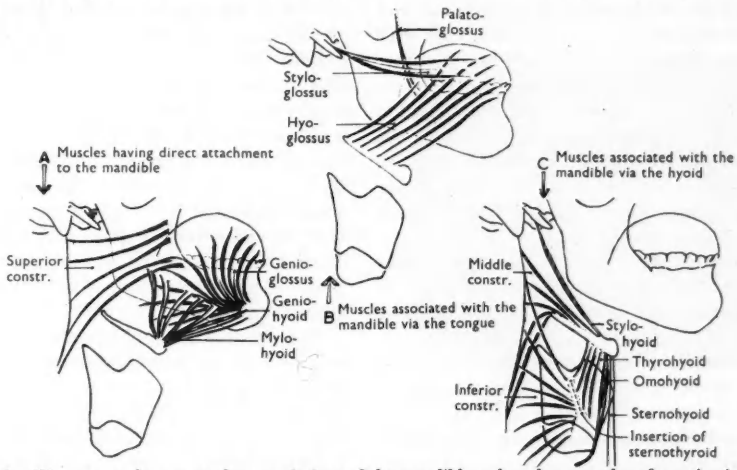


*Fig.* 8.—Diagram to show muscular associations of the mandible, other than muscles of mastication.

## THE TONGUE IN RESPIRATORY FUNCTION

The above descriptions of the activity of the tongue and larynx emphasize the role of the oropharynx as part of the alimentary tract and the question arises of the activity of the tongue at those times—the greater part of life—during which the oropharynx acts as part of the respiratory tract, conducting respiratory gases from the nasopharynx to the larynx and vice versa. In this activity the tongue serves to complete the anterior wall of the pharynx. The soft palate, which in swallowing is raised against the posterior pharyngeal wall, drops as does a valve flap and comes to lie against the tongue, forming with it a continuous surface from choanæ to larynx. The cricopharyngeal sphincter contracts and the larynx moves dorsally.

It is in this state of the patient that the mandible is described as being in the rest position. From the foregoing it can be seen that there is a component in the description additional to those of "balanced muscle tonus", condylar relations, and "endogenous posture" (Ballard, 1955). This component is the activity of the mandible as suspensor of the tongue, a function of which it is never free, just as the hyoid bone is never free of the function of supporting the larynx, and it must be emphasized that the role of the tongue as part of the anterior wall of the pharynx is not a passive one, for there must be continual adjustments of the muscle tension in response to the regular changes of intrapharyngeal pressure with the rhythm of inspiration and expiration. Nor is this consequential activity the whole story, for Mitchinson and Yoffey (1947) reported that 18 of the 23 cases they examined showed a forward movement of the tongue and hyoid bone in inspiration which may be interpreted as enlarging the bore of the respiratory tract at this point.

It is, of course, true that the tongue can close off the airway from the mouth regardless of the

position of the mandible, but this is no more than to say that a man can walk when bowed under a heavy load. Relieved of the load, he walks in a posture that is the particular approximation to upright carriage characteristic of the particular individual and expressed in a particular relationship of skull, spine, and pelvis, a relationship that is alterable only with very great difficulty. (Bick, 1948.) In other words, the tolerance limits for the effective performance of a function are wide, and a function, be it orthograde locomotion or the control of the airway, can be carried on even though the circumstances are such that the operative mechanism is prevented from working "normally".

So it is with the mandible and tongue—the particular functions of the tongue can be performed with the mandible in any one of a variety of positions, but, when no external compulsion is present (and conscious control is external in this sense so far as the reflex postural activities are concerned), a preferred characteristic posture is adopted which secures that the tongue is supported so as to complete the anterior wall of the airway.

## SUSPENSORY FUNCTION OF THE MANDIBLE

Emphasis on the suspensory function of the mandible gives support to the view that the rest position is a postural phenomenon and so suggests a physiological reason for the relative constancy which it exhibits. On the other hand there is no reason why it should be exempt from response to circumstances of the type which bring about change in other postural relationships. General postural relationships, for instance, change radically and swiftly in response to mechanical change such as the shortening of one leg which may follow a compound comminuted fracture, or the collapse of vertebræ that may follow bony tuberculosis. The postural reflexes are plastic to the extent that they ensure the maintenance of the upright posture within the limits of the altered mechanics.

It is the behaviour of the mandibular posture in this matter of response to the alteration of local mechanics that appears strange, for the removal of all the teeth would seem to rank as a major alteration of this type. Despite this, no immediate response occurs of a dimension commensurate with the lost tissues, while on the other hand, Tallgren (1957) has published data that establish that a change of this dimension does take place over a long period. Writing of patients edentulous for a long period she reported that "the rest face height with dentures gave a mean of 115·1 ± 0·95 mm. Compared with the normal material this indicates a decrease in this dimension. . . . The mean in the oldest age-group of the normal material is 124 ± 0·74 mm., indicating that the reduction of the rest face height in denture wearers is about 9 mm. Testing of these results proved the difference to be highly significant."

The question arises as to why the mandibular posture does not react immediately to the loss of the teeth and the answer surely must be that the function served is other than dental. The respiratory association of the mandible as suspensor of the tongue points quite clearly to the maintenance of the pharyngeal airway as the determinate function. Any changes that do take place on the loss of teeth must obviously be small, so small that the interpretation has arisen that none occurs. Cephalometric observations by comparison of radiographs taken before and after extractions would not be conclusive, for radiographs taken on successive occasions are subject to an experimental error that may be greater than the change in dimension it is sought to record. It is, however, possible to bring about a similar change in patients accustomed to the wearing of full dentures by the simple expedient of removing the dentures. This makes it possible to expose comparable cephalometric radiographs. Such radiographs show quite clearly that any response in mandibular posture is an incident in the response of the tongue–hyoid–mandible complex.

## PUBLISHED DATA

The response to removal of the dentures of decrease in the separation of mandible and maxilla in the rest position has been recorded

elsewhere. Thus Olsen (1951) reported that 82·9 per cent of the group of 70 patients that he examined showed a greater face height with full dentures in place than with the dentures removed. Tallgren (1957), reporting on the same group of edentulous patients as noted above, wrote: "the rest face height without dentures gave a mean of 113·6±0·98 mm., i.e., about 1·5 mm. less than the corresponding result for the rest face height with dentures. In order to confirm this result statistically, the difference between the corresponding distances was calculated for each of the subjects (44) as well as the mean and other characteristics of these differences. The mean for the differences was 1·47±0·25 mm. The testing showed a highly significant difference between the rest face height with and without dentures." Atwood (1956) reported that of 37 edentulous patients 25 showed a decrease of rest face height on removal of dentures. Of these 25, in 14 the difference was markedly greater than the difference between successive determinations at the same sitting.

In another connexion, Gwynne-Evans (1948) reported on a case which showed very clearly how sensitive the rest position of the mandible is to alteration in the respiratory function. The patient was a child submitted to tonsillectomy. Lateral radiographs taken before and after the operation show establishment of a linguopalatal seal after the operation and, accompanying this change, a very obvious decrease of the intermaxillary separation.

Tallgren's report of reduction in resting face height of 9 mm. observed in a group of long-edentulous patients (all wearers of full dentures) as compared with a control group of normal patients, is to be related to the further reduction in the volume of the contents of the oral cavity that arises by the progressive loss of the edentulous alveolar ridge. This loss has a consequence that is a commonplace of clinical prosthetics, the "spreading of the tongue" (*Fig.* 9). In patients who have lost teeth, the tongue may be seen to lie over the edentulous alveolus and to make contact with the tissues of the cheek intruding from the buccal side. It is, in fact, occupying the space formerly occupied by the teeth and the lost portion of the alveolus and, in order that it should do so, the tongue must either have enlarged or some redistribution of its bulk must have taken place.

The first alternative, enlargement, may be by means of œdema, fibrosis, or hyperplasia, but none of these is a usual accompaniment of the condition. On the other hand, on the

*Fig.* 9.—Spreading of the tongue into an edentulous area.

analogy of what is observed when full dentures are removed, a redistribution of bulk is a not unreasonable hypothesis. Such a redistribution would take the form of an increase of the volume of the tongue present in the anterior part of the oral cavity and the automatic consequence would be reduction in the volume of the posterior part. When this redistribution is of small dimension the soft palate can accommodate itself to the forward movement of the posterior part of the tongue, but when it is large, it cannot occur without prejudice to the effective performance of the respiratory function, and the raising of the mandible in the rest position, i.e., when the tongue is active in this function, would be a not unexpected response. Such an alteration would have the effect of decreasing the volume of the oral cavity and at the same time would bring about compensation by raising the tongue itself via the direct and indirect muscle attachments.

## RECONCILIATION OF CONTRADICTORY EVIDENCE

It would thus appear that the description of the mandible as suspensor of the tongue and the acceptance of the implications of the

recognition of the respiratory function of the tongue offer the means of reconciling the apparently contradictory evidence that (1) the posture of the mandible is stable and identifiable (an hypothesis that has served well as a clinical tool), and (2) that this posture is subject to long-term changes (an observation derived from clinical impressions and confirmed by the work of Atwood, Tallgren, and Olsen quoted above).

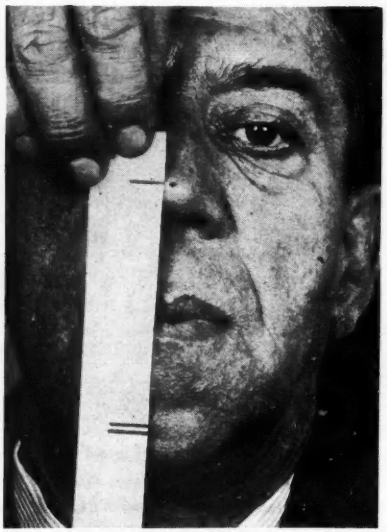

*Fig.* 10.—Patient in rest position with dentures in place. Of the two lower marks, the upper corresponds to the position of the mark on the chin with the dentures removed.

It seems that the preservation of the relationship of the teeth is not a primary factor in establishing the rest position of the mandible at a particular level, but that the teeth enter into this process indirectly. They enter into it by virtue of the fact that they occupy space in the oral cavity and when they are removed, the conditions are altered in which the tongue performs its respiratory function as part of the anterior wall of the pharynx. The loss of the teeth deprives the tongue of peripheral support and alterations in posture are made to compensate for the absence of the teeth, not as teeth, but as elements occupying space in the oral cavity. Tallgren's work shows quite clearly that this process of compensation is carried on as the alveolus is lost, and she has published lateral radiographs of patients, wearers of full dentures for many years, in whom there is marked reduction of rest face height, notwithstanding

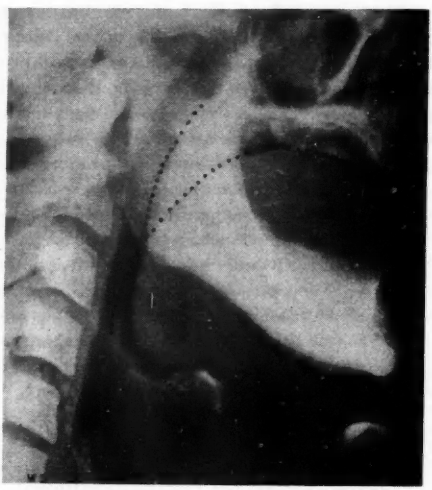

*Fig.* 11.—Rest position, showing response to removal of dentures by change in posture of tongue and hyoid, without change in position of mandible.

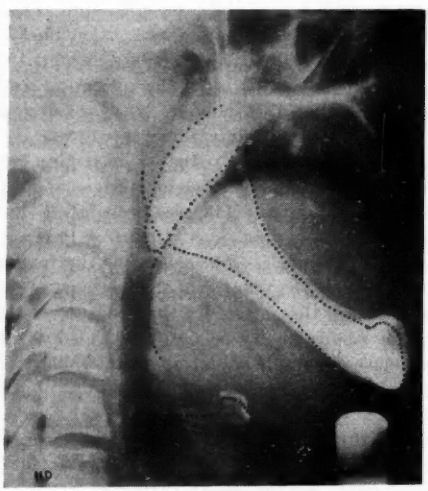

*Fig.* 12.—Rest position, showing response to removal of dentures by change in posture of tongue, hyoid, mandible, and soft palate.

the presence of a greatly enlarged interocclusal clearance.

The alterations in posture following the loss of the dental structure are not necessarily the same for all patients. It would be surprising if they were, for the dimensions, relations, and amplitudes of movement of the parts concerned offer manifold possibilities of variations from individual to individual. Consequently, the outcome of loss of teeth may be for one person a reduction of rest face height (*Fig.* 10) while for another it may be a re-arrangement of the mass of the tongue, without any apparent change in the position of the mandible (*Fig.* 11). In some, and probably in all in whom the loss of dental tissue is severe, tongue, hyoid, and mandible may all participate (*Fig.* 12).

## CLINICAL IMPLICATIONS

From the point of view of clinical practice this conception of the role of the tongue illuminates some important phenomena associated with the bite relationship in the edentulous patient, although no useful purpose is served by an attempt to identify and measure the respective contributions of the structures concerned. For instance, it is a common observation that the normal procedure of deducing the occlusal face height (i.e., the height of the bite) by so cutting the wax bite rims that an interocclusal clearance can be observed will sometimes result in the presentation of a "high bite", i.e., an excessive jaw separation, at the succeeding visit when the waxed-up dentures are tried in. It is not difficult to see how this may arise if the bite rims occupied more space than the artificial teeth, as they frequently do, or if the bite rims were so located as to restrict the tongue more than the teeth do.

It is a reasonable deduction that the clinician should decide and record, in the shape of the bite rims, the most precise details possible concerning the location and dimensions of the proposed artificial teeth. The writer is informed, by one of De Van's pupils, that De Van propounded this teaching in his lectures (Derrick). In other words, the dimensions of the teeth and their relationship to the edentulous ridges should be decided by the dentist at the chairside from a consideration of the patient, not by the technician in the workshop from a consideration of the models. Every endeavour should be made to locate and record at the chairside the potential space described by Fish (1952).

Another practical consequence of the reaction of the tongue to the presence of the substitute teeth is that it is not necessarily correct to base the determination of occlusal face height with bite rims in upon the record of rest face height with the rims out. Whether it is correct or not depends upon whether the reflex adjustment to the presence of substitute teeth affects the mandible or not. If it does, the occlusal face height finally decided upon will be less than it should be. The safeguard against this error is to check that, when the bite rims have been finally trimmed and adjusted (including the adjustment of lateral bulk and location), the patient demonstrates an identifiable rest position and an interocclusal clearance of acceptable dimensions.

The clinical consequences of error in the recording of the occlusal face height are more commonly obtrusive when the error is one of over-estimation. Patients in this predicament say that they have to keep their teeth clenched all day. Sometimes such a patient will say that not only are the lower ridges hurting, but also that the throat is sore and that the whole of the front of the neck is painful. These symptoms may plausibly be explained as a consequence of enforced increase in the separation of mandible and maxilla in that an excessive burden is imposed on the suspension of the tongue and upon the associated structure in securing the effective completion of the anterior wall of the pharynx, and the clenching of the teeth is directed toward reducing the volume of the oral cavity to the possible minimum in order to facilitate the performance of this function of the tongue.

This phenomenon of the "raised bite" that is discovered only when the dentures have been completed may be attributed to errors in processing. It is possible, however, that the error may have arisen in clinical procedures and may be capable of interpretation in terms

of the functional demands, not of the tongue in speech or in manipulation of the food in the oral cavity, but of the tongue in its activity as a part of the pharyngeal airway.

With regard to definition, the foregoing can add nothing to that due to Atwood (1959). He describes the rest position of the mandible as "the habitual postural position of the mandible when the patient is at ease in the upright position", and it is the presence of the words "at ease" that make this definition so appropriate. They imply that all physical functions are suspended save those that are necessary for the maintenance of normal metabolism in the fully conscious patient, and it is this physiological and anatomical norm that is displayed in "the rest position of the mandible".

## SUMMARY

Data are presented, from reports by other authors and from the present writer's records, in support of the contentions (1) that it is the posture of the tongue in respiratory function that is the primary determinant of the rest position of the mandible, and (2) that the teeth enter into this determination indirectly as tissues occupying space in the oral cavity. The effects of the removal of the teeth on the form of the tongue and the relationship of these effects to change in the vertical dimension and to some difficulties in the wearing of full dentures are discussed. The morphological and functional anatomy of the muscles that are concerned is described.

**Acknowledgements.**—The writer wishes to express his thanks to the radiographers of The London Hospital Out-patient X-Ray Department for their co-operation in obtaining the radiographs, and to The London Hospital Photographic Department for the reproductions of the drawings and radiographs.

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## A Quantitative Method for the Evaluation of the Soft-tissue Facial Profile

A method is introduced to evaluate the soft-tissue profile on photographs or radiographs. Angular relationships are established between upper lip, lower lip, and chin. A group of normal occlusions and a group of malocclusions were studied and the measurements evaluated statistically.—MILTON NEGER, A. B., and NEWARK, N. J. (1959), *Amer. J. Orthodont.*, **45**, 738.

J. BERESFORD

# A DENTAL PROBE AS A FOREIGN BODY

By **D. H. GOOSE**, B.Sc., B.D.S.

*Lecturer in Preventive Dentistry, School of Dental Surgery, University of Liverpool*

THE inhalation or swallowing of foreign bodies in dental procedures is fortunately uncommon (d'Abreu, 1950), but they do occur and Hagens (1953) has classified them into three groups:—

1. A tooth or portion of tooth, an inlay or filling, tartar, pieces of plaster impressions, or a broken part of an instrument slipping from the grasp of a dentist while operating.

2. The poor condition of a patient's natural or artificial teeth may lead to inhalation of fragments without operative interference.

3. The manipulation of gags in the surgery of the mouth, such as in tonsillectomies, etc.

*Fig.* 1.—Showing the broken fragment of probe point in the duodenum.

## CASE REPORT

The present case involved the unusual occurrence of the swallowing of a fragment of dental probe, which broke off during the routine examination of a patient in the Department of Preventive Dentistry in Liverpool.

The patient was a girl, 10 years of age, attending the department for routine examination. During the examination of an upper first molar the probe, a single-ended sickle-shaped one, broke. The probe point could not be found in the mouth, on the patient's clothes, or in the surgery. At first she said she did not feel anything at all, but later, on closer questioning, admitted she remembered swallowing something.

In view of the doubt involved, she was referred for chest and abdominal radiographs, which were taken later in the day and revealed the broken fragment in the duodenum (*Fig.* 1). She was consequently admitted to the Children's Hospital to be kept under observation, during which time no symptoms developed and she was discharged 5 days later, there being no longer any evidence of the fragment radiographically.

The remaining part of the probe is shown in *Fig.* 2, and the metallurgical report indicated that it was a fracture of the brittle type, there being no evidence of the presence of any crack prior to the time of final rupture. The metal appeared to be in an unsatisfactory state, possibly due to faulty heat treatment (*Fig.* 3).

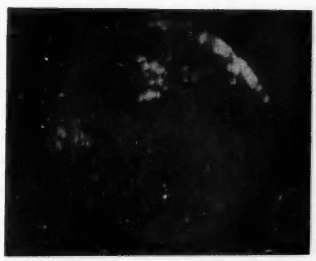

*Fig.* 3.—The unsatisfactory state of the metal, possibly due to faulty heat treatment.

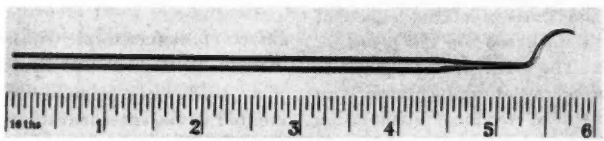


*Fig.* 2.—The remaining part of the probe.

## DISCUSSION

The reason for reporting this case was the unusual nature of the foreign body and the

suggested necessity for caution in using probes, particularly when the patient is tilted back for the examination of upper teeth.

It also stresses the need for prompt action in obtaining radiographic evidence of the position of the foreign body and in arranging any necessary treatment. Fortunately, as Roy and Vinson (1958) say, a foreign body which reaches the gastro-intestinal tract below the œsophagus is usually expelled spontaneously and surgical removal is seldom indicated. In this case the patient suffered no discomfort and is now continuing her course of dental treatment satisfactorily.

**Acknowledgements.**—I would like to record my thanks to Dr. S. J. Kennett, of the Department of Metallurgy, University of Liverpool, for his help in the metallurgical report, and to Mr. J. S. Bailie, Photographer to the Dental School, for his photograph of the X-ray.

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**Phenytoin Gingival Hyperplasia and Chronic Gingival Irritation**

Phenytoin has been the drug of choice in the treatment of epilepsy for more than twenty years and one of its toxic manifestations is overgrowth of the gingival tissues. The lesions are described as a painless hyperplasia, affecting especially the anterior region of the mouth. This condition shows a different picture when complicated by oral sepsis, for then there are hæmorrhages and secondary pigmentation. Microscopically there is an epithelial proliferation and a pronounced increase in connective tissue fibres, together with considerable numbers of lymphocytes and plasma cells in the exudate.

Vitamin deficiency and allergy have been discounted as causative factors, but some prominence has been given to the role that epilepsy may have in adrenocortical dysfunction and that the anticonvulsant effect of phenytoin may be mediated via the pituitary adrenal complex. The gingival hyperplasia is then to be regarded as an exaggerated connective tissue response to local stimulation occurring in subjects with deranged adrenocortical function.

A survey was carried out in a mental hospital and 50 patients were selected who had some of their own teeth and who were receiving phenytoin 0·1 grain t.d.s. They were dentally examined and special attention was given to oral hygiene, the state of the teeth, mouth-breathing, and the degree of hyperplasia.

The first table of results shows that of the 50 epileptic patients 18 have normal gingivæ, 29 have varying degrees of hyperplasia, and 3 are so badly affected as to interfere with the function of the teeth. A control group not on phenytoin and not all epileptics shows 37 with normal gingivæ and 13 with slight thickening of the papillæ. Further tables indicate a close connexion between neglected oral hygiene and the presence of hyperplasia; this cause and effect is intensified in the lower intellectual or idiot-imbecile category. A similar state of affairs exists in the mouth-breathing group.

It is concluded that all patients on phenytoin therapy have a susceptibility to gingival hyperplasia, and if their oral hygiene is poor, and especially if they are mouth-breathers, this effect is accentuated.—Collins, J. M., and Fry, B. A. (1960), *Aust. dent. J.*, **5**, 165.

G. E. B. Moore

**Effect of Somatotropic Hormone on Gingival Wounds in Normal and Protein-deprived Rats**

A study of gingival injuries surgically created in the interdental papillæ between the maxillary left first and second molars of young adult male rats showed that injection of somatotropic hormone increased the rate of osteogenic activity at the alveolar crest. This activity was present even in a group of animals subjected to protein deprivation at the time they received the S.T.H. injections. —Stahl, S. S. (1959), *J. Periodont.*, **30**, 158.

A. B. Wade

# SOME STRUCTURAL CHANGES IN PERIODONTAL DISEASE*

By **HOLGER THILANDER**, L.D.S.
*Royal School of Dentistry, Umeå 2, Sweden*

EXAMINATIONS using the electron microscope of certain particular features in periodontal disease in experimental animals showed alterations in the cementum structure as well as in the collagen fibres of the periodontal membrane. The fixing medium used was 1 per cent solution of veronal buffered osmium acid, and after the fixation some specimens were decalcified in E.D.T.A. at an alkaline *p*H. About 800 electron micrographs were made from 40 specimens.

A comparison was made between specimens treated with E.D.T.A. and those sectioned without treatment with this medium. This comparison revealed that the structure of the cells was affected by this decalcification while the morphological structure of the collagen appeared to be unchanged. Before dealing with the pathological changes in the collagenous substance of the cementum and the fibres of the periodontal membrane, the morphology of this region as observed in the electron microscope was outlined.

In periodontal disease certain dissolution processes were demonstrated, particularly on the border between the cementum and the dentin, causing an undermining of the attachment between these two structures. This particular type of dissolution was not restricted to the more advanced cases; even in the initial stages of the disease this process progressed in a similar way. When this dissolution was found to originate at the cementum surface, it penetrated through the cementum and on reaching the dentine, proceeded along the cemento-dentinal junction.

The dissolution of the collagen in the periodontal membrane was mainly confined to the region just below the epithelial cuff. Outside this region the collagen under the pocket epithelium seemed to be unchanged. This might indicate that bacterial products penetrate between the epithelial layer and the hard substance of the tooth, but that penetration through the epithelial layer itself only takes place to a limited extent.

Further investigations on human material are in progress.

* Summary of a lecture given at the meeting of the British Society of Periodontology, held on April 6, 1960.

## ARPA INTERNATIONALE

The XVIth International Congress of ARPA was held in Vienna, Sept. 15–20, 1960. About 900 persons were present from 24 countries.

The principal theme of the Congress was "Prostheses and Periodontology", though many communications were presented on other topics. In all about 80 papers were read. Preceding the formal opening of the Congress a day was devoted to a free discussion on the "Epidemiology of Periodontal Diseases".

Honorary membership was bestowed upon Professor Stefan Loos, of Vienna, and Professor Oreste Louridis, of Athens, while associate membership was conferred upon Dr. E. C. Fox, of Birmingham, Professor Lazar Petrovic, of Belgrade, and Mr. Bryan Wade, of London. This latter honour is equivalent to honorary membership, but the rules of the Association allow honorary membership to be given only to persons whose national association is a constituent member of ARPA Internationale.

There was a most encouraging entry of 22 theses for the René Jaccard Prize which was awarded to Dr. Gösta Forsslund, of Stockholm, for "The Structure and Function of the Capillary System in the Gingiva in Man". Dr. Heyman Krømer, of Oslo, received the second prize for his work on "Bone Homografts in the Surgical Treatment of Cysts of the Jaws and Periodontal Pockets".

The next meeting will be held in Athens at Easter time, 1963.

# BOOK REVIEWS

**A MANUAL OF PRACTICAL ORTHODONTICS.** By W. J. TULLEY, B.D.S., F.D.S. R.C.S., D.Orth. R.C.S., Reader in Orthodontics, University of London, Dental Department for Children, Guy's Hospital, London; Extra Mural Lecturer, Eastman Dental Hospital, Institute of Dental Surgery, London; and A. C. CAMPBELL, B.D.S., F.D.S. R.C.S., M.R.C.S., L.R.C.P., D.Orth. R.C.S., Consultant Orthodontist, Hammersmith Hospital, Postgraduate School of Medicine, London; Consultant Dental Surgeon, Paddington Green Children's Hospital (St. Mary's Hospital); Late Senior Registrar, Dental Department for Children, Guy's Hospital, London. $8\frac{3}{4} \times 5\frac{1}{2}$ in. Pp. 220+xii, with 237 illustrations. 1960. Bristol: John Wright & Sons Ltd. 42s.

THE authors of this book have gained their experience in London and it can be fairly said that it represents not only their views but also the views of many of their London colleagues. Within the compass of 220 pages the book claims to be a concise survey of current British thought on orthodontics. It is likely that reactionary elements in orthodontics both in the British Isles and the Commonwealth will not agree with this. In the words of the preface, it attempts, perhaps too briefly, to present a scientific approach to the subject of orthodontics. The book is designed to meet the requirements of the undergraduate and the practitioner and to act as a general basis for reading for postgraduates; in particular the section on treatment is specially designed "to help the student and the practitioner by illustrating specific cases and the appropriate treatment", thus enabling the practitioner to select his cases. Unfortunately it is not at all certain that these three main objects are achieved within the 220 pages. The first section of the book on the growth and development of the dentition and the aetiology of malocclusion is a concise statement of what is now generally accepted, but little evidence has been produced for many of the statements made. As a result it might be that neither the practitioner nor the undergraduate will see the significance of the facts presented, particularly as they apply to other aspects of dentistry. The same criticism of excessive brevity might also apply to the sections on treatment. As is stressed earlier in the book malocclusions are the result of the intra-relation between the facial skeleton, the soft tissues, and the teeth. The dust cover says that specific cases have been illustrated with the appropriate treatment, thus enabling the practitioner to select his cases. Although this section does illustrate very well the relationship between treatment planning and the morphological complex of the patient, it is very doubtful whether the variety of morphological complexes which will be met with in the population are described in sufficient detail for the practitioner to be able to select the correct treatment for any one patient. As far as the techniques of treatment are concerned, the preface says that the accent is almost entirely on removable appliances "as we believe that with few exceptions a satisfactory result can be obtained in this way". One cannot help relating this aim to the statement made by Mr. Rix in the foreword, when he says that "orthodontic treatment in general terms aims at making a compromise with nature in order to improve appearances and to create stable conditions which favour the long term survival of a healthy dentition". Many orthodontists and their colleagues in other branches of dentistry would not agree that satisfactory compromises can be produced with removable appliances such that they "favour the long term survival of a healthy dentition". Particularly will this be so when the compromise involves the extraction of teeth not solely for orthodontic purposes but because of the added complication of caries.

Every now and again in the book one comes across what might be called colloquialisms. It is difficult to avoid introducing such colloquialisms into one's expression of thought when new ideas are being developed, but to the stranger to the schools of thought which

they represent they may not convey the correct meaning.

The criticism that the book is too brief for a true comprehension of the subject might not be correct. However, it is a text-book to be recommended.

The authors are to be congratulated on the selection of illustrations and the publishers on their reproduction. John Wright & Sons Ltd. may also be thanked for producing a text-book which for them completes a trilogy expressing progressive British thought in orthodontics.

C. F. B.

**ORAL PATHOLOGY.** An Introduction to General and Oral Pathology for Hygienists. By DONALD A. KERR, B.S., D.D.S., M.S., Professor and Head, Department of Oral Pathology and Periodontics, University of Michigan School of Dentistry; and MAJOR M. ASH, jnr., B.S., D.D.S., M.S., Associate Professor of Oral Pathology and Periodontics, University of Michigan School of Dentistry. $9\frac{1}{8} \times 6$ in. Pp. 205, with 110 illustrations. 1960. London: Henry Kimpton. 45s.

TEXT-BOOKS on oral pathology for dental students are written on the assumption that the reader has completed an adequate course of general pathology. In this book, aimed at the dental hygienist, the authors have had to include a preliminary section on the basic principles of pathology, and it must be admitted that this is a formidable task when the size of the complete book must be strictly limited. It would, therefore, be uncharitable to be critical of the introductory chapters when the text has of necessity been subjected to extreme condensation. Considering that this section starts with an introduction to the cellular basis of life and then proceeds to cover all the principal pathological processes, the authors are to be commended on a remarkable achievement. Information and repair are given the relative amounts of space their importance requires, although the description of these processes and of hyperplasia are marred by the repeated use of the word "altruistic", which in these contexts must surely represent an extreme in teleology. Also unconventional is the authors' definition of infection, which, they stress, is the reaction of tissue to the presence and multiplication of micro-organisms. Oral examples are used to illustrate principles and the transition from general to special pathology is easy and almost imperceptible. As could be expected, the chapter on stain and accretions is most competent. Dental caries is dealt with in a neat and workmanlike manner although naturally not so extensively as is periodontal disease. The concluding chapters on stomatitis and neoplasia are brief résumés of these fields, but should serve to make the reader aware of the scope of the subject. This book will not only help to increase the hygienist's interest in her work, but will extend the value of her service to her patients. Incidentally, dental students in their early clinical phase will find here a short and concise introduction to the larger standard works.

J. A. P.

## LETTER TO THE EDITOR

*December* 15, 1960.

Dear Sir,

On reading the recent article by Mr. Edgar Gordon entitled "An Instrument for Measuring the Lengths of Root Canals", we were surprised that the author should go to such lengths of ingenuity and yet fail to understand the purpose of this measurement. We would suggest that accurate determination of the root length is essential to enable *accurate reaming*, as well as accurate filling, to be accomplished. If reaming is begun before the position of the apex is known, this may result in one of two undesirable consequences. The apex may be penetrated and the periapical tissues will be unnecessarily traumatized or the canal may be reamed short of the apex, leaving the all important apical portion uncleaned, possibly also forming ledges which make further reaming very difficult. Mr. Gordon's technique requires that the canal be reamed and sterilized before his device can be used, and thus puts the cart before the horse.

The quickest, simplest, and most effective means of achieving a sterile canal free of symptoms is to ream exactly to the apex, and to do this one must know where the apex is; for a sound exposition of the basic pathology and aims of root-canal therapy which supports this contention we refer to Lester Cahn (*Brit. dent. J.*, 1955, **98**, 245) with special reference to his treatment of infected teeth.

Yours faithfully,

H. ALLRED
J. R. GRUNDY
S. D. HATT

*Turner Dental School,*
*Bridgeford Street,*
*Manchester* 15.

# ABSTRACTS FROM OTHER JOURNALS

## An Approach to the Practice of Oral Medicine

The diagnosis of all mouth conditions is the business of the dentist, although the treatment may not be. Thus the subject of oral medicine is considered mainly as an aid to diagnosis of oral lesions which are classified as: (1) A local process; (2) A local process predisposed to by a systemic disturbance; (3) Part of a general disease.

1. Oral lesions of local origin are the most common of all human diseases; notably caries, gingivitis, and their sequelæ. Other mouth lesions of local origin range in diversity from injuries due to trauma to developmental abnormalities and tumours. Most are not difficult to diagnose except perhaps self-inflicted wounds (when the case-history is non-revealing) and contact allergies. Failure to diagnose malignancies is unforgivable.

2. Local processes predisposed to by systemic disturbances include, for example, deficiency states (vitamins and elements), hormonal disturbances, blood diseases, and the effects of drugs and poisons. The health of a tissue depends on the metabolic activity of its individual cells. Normal metabolism of a cell depends on the constancy of its environment as well as on the integrity of the protoplasm of its nucleus and cytoplasm. Damage to the nucleus may result in death of the cell or it may cause a change in the function or character of the cell. All factors predisposing to oral disease act by changing the environment of the individual tissue cells. It is suggested that these systemic tissue factors do not produce oral lesions *per se* unless their quantitative lack or presence is of such a degree that concomitant lesions appear elsewhere in the body. It is thus implied that those oral lesions which are usually ascribed to systemic disturbances, such as deficiency states, blood dyscrasias, etc., do not normally occur in the absence of a local exciting factor. It is also suggested that the existing factors responsible for oral lesions in these patients are the same as those which cause oral disease of strictly local origin, but that the response of tissue is much more pronounced when there is a predisposing factor present.

3. The diagnosis of the general diseases of the body manifesting oral lesions and the treatment of such oral lesions are the concern of the dentist. Such general diseases are:—

*a.* Those involving the salivary glands, mumps (usually readily diagnosed), and the rare and untreatable disease of Mikulicz.

*b.* Those involving the oral mucosa and the skin of the lip. Common ones in this group are the acute infective fevers, infective granulomata, and numerous skin diseases. Unless the oral symptoms predominate the dentist will seldom be called upon to diagnose these diseases. Oral lesions occurring in skin diseases may lead to confusion if they are the first or only symptoms of the disease to appear. Diseases of this sort which should be kept in mind are herpes simplex, lichen planus, erythema multiforme, and pemphigus.

*c.* Those involving the general systems of the body. This may occur in two ways: by direct involvement of that part of the same system represented in or around the jaws, and by secondary effects on the oral tissues due to disease of a particular system. As an example of the first method of involvement, in disease of the gastro-intestinal system, intestinal polyposis is important to the dentist. These polypi may become malignant, and patches of brown pigmentation associated with them appear in the palate, gums, lips, and skin around the mouth and nose. The patient may seek advice from the dentist about the pigmentation, and it is not to be confused with that occurring in dark-skinned races or Addison's disease. In regard to involvement of the oral tissues by disease of a particular system many examples are given which include the muscular and nervous systems. It is to be borne in mind that the jaws are involved in many of the general diseases which attack the skeletal framework.—DODDS, A. G. (1960), *J. Dent. Ass. S. Afr.*, **15**, 180.

G. E. B. MOORE

*BRITISH SOCIETY FOR THE STUDY OF PROSTHETIC DENTISTRY*

# ABSTRACTS FROM THE SIXTH ANNUAL MEETING, 1959

## A CLINICAL STUDY OF FULL DENTURES

### WEAR OF ACRYLIC POSTERIOR TEETH

By **ARNOLD S. T. FRANKS**, B.D.S., L.D.S.

*Department of Prosthetics, Institute of Dental Surgery, University of London, Eastman Dental Hospital*

THE study was founded on an analysis of full dentures with which both dental surgeon and patient were satisfied at the time of insertion. It was also based on an investigation of accepted methods—which rest for acceptance on *clinical impressions* rather than on a scientific evaluation through statistical analysis with adequate controls.

A general outline was given of how the study was conducted. Three hundred and eighty-eight patients were contacted who had worn full upper and lower acrylic resin dentures for a period of 5 years. Of this number 140 attended for examination. The percentage attendance was analysed relative to its influence on the typical nature of the reviewed cases. An age–sex distribution curve showed that those analysed were a typical cross-section.

The methods used for control of the reliability of the clinical observations were described. They consisted of a correlation of the independent assessments by two observers of a number of the clinical factors under investigation.

An analysis was presented of one of the aspects which had been investigated, i.e., wear of acrylic posterior teeth. The more important findings were summarized:—

1. Wear of acrylic posterior teeth caused loss of occlusion in centric relation—resulting in the patient assuming a protrusive jaw relationship of progressive severity in order to achieve a centric occlusion (position of maximum tooth contact).

2. The more satisfactory the dentures were from a clinical standpoint the more wear there occurred of the occlusal surfaces of the teeth.

3. There was no correlation between tooth-wear and the period for which dentures were worn, which suggests that wear was due to food abrasion and not tooth contact.

4. There was a significant correlation between free articulation and the degree of acrylic posterior tooth wear.

### *DISCUSSION*

Mr. J. Anderson quoted from a recent survey that he had carried out on dentures fitted by himself, or under his supervision, to the effect that wear similar to that noted by the speaker had been observed, but without the same correlation. Of these dentures, fitted over a period of 5 years, 42 per cent required relining. Professor A. Mack asked if abrasive cleaners might not have had a part in the wear observed. He mentioned effects due to special elements of diet, e.g., persistent sucking of peppermints. Professor A. O. Chick asked if any manufacturing factors were present. He stated that he had frequently observed the retention of interdigitating cusps despite marked wear. Mr. Hamish Thompson reported wear associated with the eating of salads and peculiarly resistant sweets. Mr. K. P. Liddelow stated that experience similar to that of the speaker had led him to abandon the use of acrylic posterior teeth. He quoted Craddock on the advantages of artificial teeth and Matthews on the regional variations in the social acceptability of full dentures. Professor E. Matthews elaborated on the quotation above by describing cases in which regional influences were predominant over what might have been expected to be overwhelming cultural factors.

*Reply.*—Mr. Franks stated that the teeth described all came from one manufacturer. He considered that abrasive cleaners would give rise to effects easily distinguishable from those with which his report was concerned.

# CLINICAL EXPERIENCE WITH ONLAY APPLIANCES

By **PHILIP SAUNSBURY**, M.Sc., L.D.S.
*School of Dentistry, Queen's University of Belfast*

THE use of removable splints which cover and give additional height to the occlusal surfaces of natural teeth has been advocated to rehabilitate the occlusal relationship in certain surgical and pathological conditions. These appliances resemble, or are part of, metal skeletal partial dentures and are intended to be "permanent" restorations. The purpose of this report is to review a group of patients treated in this way to see if the appliances provided met the accepted requirements of removable prostheses.

The group under review consisted of 75 patients who were able to attend for check visits every 3 months during the first year, and every 6 months subsequently up to a maximum of 5 years. The clinical conditions for which this type of treatment was prescribed were similar to those described by Lammie, Storer, and Osborne (1956), as was the technique of construction of the chrome-cobalt based onlay appliances.

An analysis of the clinical results of the treatment shows that over half the patients (52 per cent) had to discard the appliances during the first 2 years and only 30 per cent were able to tolerate the appliances for 3 years or more.

A further analysis of the reasons for discarding or modifying the appliances included decalcification or caries of the covered teeth (48 per cent), movement of teeth or change in natural occlusal relationship (30 per cent), periodontal breakdown of covered teeth (12 per cent), and interference with comfort, speech, or mastication (10 per cent).

It would therefore appear from this review that the removable onlay appliance does not meet the requirements of an acceptable prosthesis.

REFERENCE

LAMMIE, G. A., STORER, R., and OSBORNE, J. (1956), *Brit. dent. J.*, **100**, 32.

## *DISCUSSION*

Mr. Fish stated that in his experience there were positive gains to be obtained in the use of onlay appliances in the treatment of derangement of the masticatory apparatus, but the dangers referred to by the speaker were real, the implication being that such appliances could be used only in carefully selected cases. Mr. Baird expressed scepticism over the possibility of the restoration of the occlusal relationship of displaced molars or the possibility of retaining all the teeth. Dr. Lammie noted the value of these appliances in bringing about a change in rate of loading. Mr. Watt described the onlay technique as an application of prosthetic devices to restorative dentistry.

# A METHOD OF CHECKING THE RECORDING OF JAW RELATIONSHIPS FOR FULL DENTURES

## BASED ON THE WORK OF COLONEL BREWER, U.S.A.F.

By **HAMISH THOMPSON**, L.D.S., H.D.D., D.D.S.
*Eastman Dental Hospital, London*

THE objective in registering jaw relationships is to register the centric position of the mandible in its relation to the maxilla and to record this accurately on an articulator. In order to check this record a registration is made on the articulator and then checked in the mouth. The method is to fix three pins to the upper and lower bases respectively so that each upper and lower pin is in point-to-point contact in the incisor and both molar regions. The bases carrying the pins are then transferred to the mouth and the mandible made to close into the desired position once more. If the pins come into point-to-point contact in the mouth, the jaw relationship could be said to be similar to that recorded on the

articulator; if not, it should be re-registered. This is achieved by mounting cups on each of the three lower pins so that the base of each cup is level with the top of each lower pin. The incisor cup is filled with compound and while still soft the jaw relationship is registered by the upper pin making a mark in the compound of the lower cup. This is repeated using the other two cups. The relationship thus registered is then remounted on the articulator. The pins are re-adjusted into point-to-point contact and checked again in the mouth. This procedure should be repeated until relationship in the mouth coincides with the relationship on the articulator.

A series of slides demonstrating the method and a report on 31 cases where the jaw relationships had been checked by this method were given. In all but 2 cases a re-registration was necessary.

### *DISCUSSION*

Mr. Bates suggested that an uneven contact was likely to arise at the check stage. Mr. Neill referred to the errors that were inevitable with the use of wax in this process and proposed plaster as a very reliable substance. Mr. Storer briefly described the type of wax rim employed by Brill, in which a knife-edge of composition is arranged to close in to soft wax on the opposing rim and recommended it as reducing contact with the cheeks and so dislodgement. Mr. Liddelow spoke of the uncertainties in setting up with the technique described and suggested that, considering the low stability of the teeth during processing, there was not much to be gained by this method. His own experience was that processing introduced errors in contact, regardless of the bite technique employed. Mr. Everett spoke of the improvement in accuracy of bite recording employing narrow bite rims. Mr. Thompson, in reply, emphasized that in this technique the operator in actual fact did the registration, it being important to ensure that the patient was as relaxed as possible, possibly with the aid of sedatives. In reply to Mr. Neill, he described the technique in which plaster was employed to make a preliminary bite recording, the method being to adjust bite rims to the correct vertical height and to cut a gutter in the lower rim to be filled with quick-setting plaster. The speaker agreed that narrow bases were an advantage in any bite technique, and in reply to Mr. Liddelow considered that, despite the cost in time, the reduction in the magnitude of the errors justified the employment of the technique.

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# A METHOD OF INVESTIGATING CHANGES IN THE MAXILLARY DENTURE-BEARING AREA FOLLOWING THE LOSS OF TEETH

By **DAVID M. WATT, F.D.S., H.D.D.**
*Dental Hospital, Edinburgh*

A METHOD of orientating serial casts of the maxilla following tooth loss was described, and illustrations of two instruments for tracing the change in surface contour of these casts were shown. The calibration of errors in the technique was made by tracing 5 casts from 5 different impressions of the same mouth, and superimposing the traces. The impressions were taken by 5 different dental surgeons and the casts were made by 5 different technicians. The measured difference between the 5 traces was $\pm$ 0·3 mm. An attempt was made to obtain dimensions of alveolar changes by measuring from tattoo marks, but this technique was not satisfactory. Illustrations of some of the oral changes following tooth loss were shown, but the author was reluctant to give details until the study was completed.

### *DISCUSSION*

Professor Matthews paid tribute to the ingenious and imaginative approach to the problem. The evidence so far obtained by Mr. Watt suggested that the conventional period of 3 months between extraction and the insertion of dentures had little relation to the real situation. Dr. Lammie asked for more information on the tattoo data mentioned by Mr. Watt. Professor Osborne welcomed the initiation of this work and looked forward with great interest to further information. In reply to Dr. Lammie, Mr. Watt stated that tattoo marks placed on the gingival margin disappeared and the data were lost. He found also that, due to changes in the immediate neighbourhood of tattooed spots in other locations, the measurements taken from them were no real guide to overall resorption. The histology of the tissues after tattooing would be of interest. He said also that the tattoo marks were so large as to give only an approximate measurement.

# A STRESS-BREAKING CLASP FOR MANDIBULAR FREE-ENDING SADDLES

By **ERIC A. SCHER**, M.Sc., M.B., B.D.S., N.U.I.
*University College, Cork, Eire**

THE accompanying illustration (*Fig.* 1) shows a design for a back-action clasp which is useful in coping with retention and sinkage of free-ending saddles. Basically, it consists of a closely adapted upper static or "tight" arm, which passes around the distal of the abutment tooth terminating in a retentive buccal area below the survey line. Æsthetics permitting, it may be carried forward upon the buccal surface of the penultimate tooth, enhancing reciprocation and thus complying with the philosophy of De Van (1952), who counselled to preserve what remains. On the lingual surface of the canine the upper arm recurves, at a rounded rather than an acute angle, to continue as the lower dynamic or "free" arm, which passes distally to become incorporated in the acrylic saddle, above the termination of the lingual bar. Both lingual bar and lower arm must be relieved from the mucosa by adequate separation during construction. The gingival crest separates the upper from the lower arm. An occlusal rest is electro-welded to the upper arm so as to lie in a mesiolinguo-occlusal rest-seat cut in the abutment enamel. The integrity of contact between abutment and preceding tooth is thus maintained, and distal traumatic torque averted.

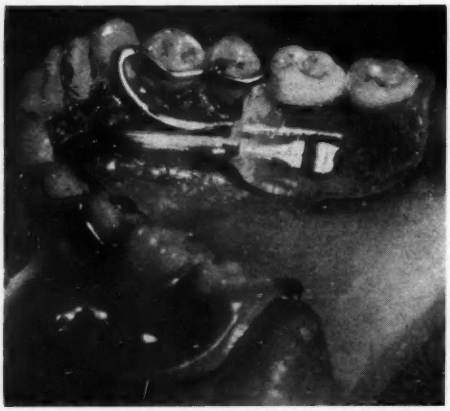

*Fig.* 1.—A back-action clasp useful in coping with retention and sinkage of free-ending saddles.

The clasp is constructed in half-round wrought stainless steel wire (Dentatus) 1·5 × 0·75 mm., the flat surface being adapted to the enamel, thus making it more rigid (Steiner, 1943).

It is hoped to investigate the suitability and durability of this design in various chrome-cobalt alloys.

* Present address, Royal Dental Hospital, London.

REFERENCES

DE VAN, M. M. (1952), *J. prosth. Dent*, **2**, 210.
STEINER, C. C. (1943), *Amer. J. Orthodont.*, **39**, 859.

## *DISCUSSION*

Professor Chick inquired about the likelihood of food impaction around appliances. Professor Mack suggested that the stress-breaking effect arose from a poor fit of the appliance on the teeth, permitting movement, rather than from the elasticity of the structure. Professor Krogh-Poulsen spoke of his own experience of such flexible devices, which was that fractures were too frequent and his practice now was to use either a rigid connector or a hinge device. Mr. Watt asked the speaker about the incidence of fractures on the occlusal rest and pointed out that the highest bearable load varies with the rigidity of the connector as shown by the work of MacGregor. He suggested that for a weak load the circumstances with this appliance were in fact the same as with a tissue-borne saddle. Dr. Scher replied that food impaction was rare, but could be dealt with by modifying the base with acrylic. In reply to Professor Mack, Dr. Scher said that 60 of 350 cases had been recalled. Of the number examined, about 75 per cent were successful and a number were not worn as a result of difficulties to be attributed to the characteristics of the abutment teeth employed. He was of the opinion that Neil's appliance was preferable in most cases, but was often excluded by economic factors. Dr. Scher compared his own experience with regard to fractures with that of Professor Krogh-Poulsen's and attributed it to the good qualities of Dentatus wire. He was anxious to compare these characteristics with those of cast chrome-cobalt. He stated his own preference for impact as against implant. In reply to Mr. Watt, the speaker said that he had carried out a period of tests on the soldered junction and concluded that the butt join was the strongest.

# DENTURE SORE MOUTH AN ENDOCRINE INFLUENCE?

By D. J. NEILL, D.F.C., F.D.S.
*Guy's Hospital Dental School*

THE local factors which might have some bearing on the aetiology of this condition were considered.

From an analysis of cases reported by Nyquist (1952) it was observed that this condition was twice as prominent among women than men and that the incidence was highest between the ages of 40–59.

Although the condition apppeared to be less frequent in occurrence in the patients presenting at Guy's Hospital, it was confined almost entirely to female patients in the fifth and sixth decades.

During the 19-month period between October, 1954, and May, 1956, 9 cases were seen in which the palatal mucosa underlying full upper dentures was chronically inflamed and the patients complained of associated symptoms. All of these patients were women whose ages ranged from 41 to 59, the average age being 51·4 years. In one case the upper denture was opposed by natural lower anterior teeth and a bilateral free-end saddle denture, but in all the other cases full lower dentures were worn. In every case one or more traumatic factors could be demonstrated, and with the exception of one case in which the patient noted worsening of the symptoms at the beginning of each period, all these women had passed the menopause.

Since it seemed likely that there might be an endocrine factor which was responsible for the lowered resistance of the tissues to trauma certain investigations were designed to assess the activity of the adrenal cortex.

Both the neutral 17-ketosteroid excretion of the urine and the blood ascorbic acid levels were found to be abnormal in affected patients and dihydro-androsterone levels were found to be markedly reduced.

The results of these investigations supported the view that variation in the tolerance in the oral tissues to different types of trauma may be accounted for in some measure by endocrine factors.

REFERENCE

NYQUIST, G. (1952), *Acta odont. scand.*, **10**, Suppl. 9.

## *DISCUSSION*

Professor Chick referred to his own published work confirming the presence of monilial infections with a variety of basic conditions. His experience was that not all monilial infections cleared with anti-fungal applications and that a low hæmoglobin had been noted in a number of cases. One case he recalled showed good recovery with iron and vitamin B. He mentioned Enlac, which appeared in some cases to bring about improvement with local application. Professor Mack spoke of clinical experience with application of hydrocortisyl, cases showing improvement during the period of application, but relapsing afterwards. Dr. Fox quoted Eisenring's paper against the view that bacterial and fungal factors were involved, but that a basic phenomenon was the atrophy in the mucosa observed in menopausal and post-menopausal females. His own biopsies showed lesions in these tissues which in some cases were erythematous and confined to the denture-bearing area. On drugs he commented that the effect of hydrocortisone was not dependable and that ascorbic acid was necessary for the absorption of iron, as can be observed in the treatment of Plummer-Vinson syndrome. He pointed out that Enlac was not a preparation of *Bacillus acidophilus odontolyticus*, but that its purpose was to provide a bacterial flora to replace that destroyed by antibiotics, in order that the dangerous prolification of yeasts might be prevented. He suggested that the presence of resistant *Bacillus acidophilus odontolyticus* might account for some of the phenomena observed by Professor Chick, and that another factor was the quality of the epithelium. Mr. Storer referred to Professor Östlund's results and the proposed employment of œstrogens to stimulate the keratinization. Dr. Fox commented on this, that keratinization does not always follow treatment with œstrogens, for the enzyme system is too complicated for this to be an automatic consequence. He pointed out also that Ziskin and Moulton's work* on the palatal and vaginal epithelium had not been found to be reproducible. Dr. Lammie said that the mucosa of the lips and of the oral cavity has something of the nature of secondary sexual characteristics. The thinning of the vaginal mucous membrane and the reduction of the plicæ resulted in a reduction of the surface epithelium and a similar process in the mouth would be expected to promote resorption of the bone by pressure. He pointed out that the steroids were cholesterol derivatives and wondered if the employment of cholesterol might be worth considering. Professor Chick commented on the unpleasant taste of hydrocortisone and referred to cases recorded by him where the signs

* *J. clin. Endocr.*, 1948, **8**, 2.

appeared outside the denture-bearing area. Mr. Watts suggested that habits such as smoking may be a factor, and pointed out that denture sore mouth did not appear in the absence of dentures and that the simple reduction of denture trauma should be an effective treatment. Mr. Baird reported a series of cases among young patients in which a marked gingivitis had appeared and in whom an examination for ketosteroids had disclosed a pre-diabetic state. In one of these cases an intractable hyperæmia appeared under a partial denture. He pointed out that hydrocortisone produced hypoglycæmia and noted that his group of patients showed a common psychosomatic state of which functional hypoglycæmia could well have been a part. Mr. Neill, in reply, referred to the interesting project suggested by Mr. Baird, and agreed that psychosomatic factors could well be involved, as, for instance, in a report of discomfort and sensations of burning in the denture-bearing area, in the presence of psychological stress.

# RESILIENT DENTURE BASE MATERIALS

By **ROY STORER**, F.D.S.

*School of Dental Surgery, University of Liverpool*

A LARGE number of resilient denture base materials have been tried and discarded over the years; this report was of an investigation to: (1) Determine the desirable properties of such a material and lay down specifications; (2) Assess by laboratory and clinical testing the most suitable material available.

Those materials tested have included: Rubbers—Vela, silicone (Flexibase, Verone, Veldent, Silyne); polyvinyl chloride (with various plasticizers); polyvinyl acetate (Jospi); acrylic copolymers (Vernosoft, Plastupalat, Flexene, Provinyl).

Laboratory tests carried out on these materials described: (1) Bond strength; (2) Water sorption, volume change, and hardness; (3) Resistance to abrasion; (4) Cleansing agents. It would appear from an overall assessment that the silicone materials show superior qualities and have the particular advantage of a self-curing technique.

The main indication for the use of such a material is in lining a full lower denture where senile or pre-senile atrophy of both hard and soft tissues of the denture-bearing area has occurred.

## *DISCUSSION*

Mr. Neill asked if the flow characteristics of the materials had been compared. Mr. Scher asked if the bacteriological state under the lining had been assessed. Professor Matthews suggested that it would be of interest to inquire from the meeting as to the frequency of use of these materials by those present. He wondered if the use of the flexible bases was not a lazy way out of problems that might be solved by full attention to mechanical and surgical measures. Mr. Lee stated his opinion that the more logical approach to cases for which use of the flexible bases might be employed was in fact to remove the causes. Dr. Lammie spoke of the atrophy that takes place in the mucous membrane of the elderly, resulting in the loss of the cushioning tissues to be found overlaying the bone in the young, and suggested that it was rational to use a material that could be expected to restore this cushioning. In answer, Mr. Storer stated that he had no information either on flow characteristics or bacteriological state, but that clinically the silicones showed no appreciable flow, nor any evidence of acting as sources of infection.

## ALBERT JOACHIM INTERNATIONAL PRIZE

Manuscripts from candidates for the Albert Joachim International Prize must be received by the Secretary-General of the Fédération Dentaire Internationale, 35 Devonshire Place, London, W.1, not later than July 1, 1961. These will be considered by the international jury appointed by the Federation and the award will be made at the XIIIth International Dental Congress to be held in Cologne, Germany, July 7–14, 1962.

Attention is drawn to the fact that the rules for this Prize have now been amended and as a result both *published* and unpublished theses on original scientific research of a laboratory or clinical nature in the field of odontostomatology carried out not longer than five years previous to July 1961 are eligible for the Prize. The 1962 award will consist of 50,000 Belgian francs (just over £300).

The full set of rules is obtainable on request from the Secretary-General of the Fédération Dentaire Internationale.

# CASES TREATED BY EXTRACTION OF PERMANENT CANINES

By **J. S. ROSE**, B.D.S., F.D.S., D.Orth. R.C.S.,
and **R. J. SHARLAND**, M.B., B.S., B.D.S., F.D.S. R.C.S.

THE problem of crowding in the upper anterior segment is most commonly solved by the extraction of two upper first premolars, and subsequent retraction of the canines followed by alinement of the incisors. However, from time to time a very satisfactory æsthetic and functional result can be obtained with the minimum of appliance therapy, by extraction of the upper permanent canines.

Cases in which removal of these teeth may be indicated are:—

1. Those in which the lateral incisors and first premolars are in contact, especially when the latter tooth does not show any rotation.

2. Where the canine has a markedly unfavourable axial inclination, with the apex lying medially near to the lateral incisor.

3. Cases in which a compromise result is acceptable if treatment time is to be greatly reduced.

A series of 9 cases was shown in which canines had been extracted during orthodontic treatment. The average time during which appliances were worn was 8 months. In no case was any flattening of the facial contour noticed, even where the extraction was unilateral. Three of the cases are illustrated here.

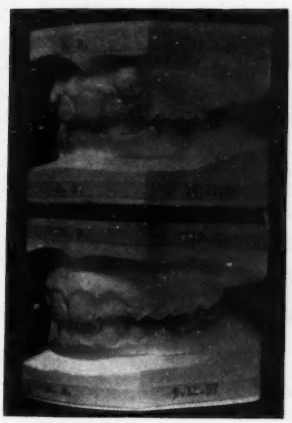

*Fig.* 1.—$\frac{5|3}{4|}$ extracted. An upper retraction plate was worn for three months.

*Fig.* 2.—$\frac{5|3}{4|4}$ were extracted. An upper retraction plate was worn for six months.

*Fig.* 3.—$\frac{3|3}{4|}$ were extracted. An upper retraction plate was worn for one year.

**Acknowledgement.**—We should like to express our appreciation to Mr. R. F. C. Thomas for the preparation of the models.

A demonstration given at the meeting held on May 9, 1960.

# A DAYLIGHT TRACING BOX

By G. H. STEEL, B.D.S. (Dunelm.), F.D.S., D.Orth.R.C.S.
*Senior Registrar in Orthodontics, Newcastle upon Tyne Dental Hospital*

It is difficult to identify the cephalometric landmarks on lateral skull radiographs when viewed in normal daylight. When tracing paper is superimposed and tracing attempted it is almost impossible. This box was developed to facilitate the tracing of lateral skull radiographs without resorting to a dark-room.

*Fig.* 1.—Tracing box in use.

Essentially, this tracing box (*Fig.* 1) consists of a cylinder having the lower end open with apertures in the top and side. The top aperture permits viewing, and is fitted with a face-piece taken from a rubber diving mask. The side aperture allows access of the hand to the interior of the box when tracing. It is fitted with a light-proof cuff, the 3-in. wrist portion of a black rubber glove serving this purpose. The lower border of the cylinder is covered by split rubber tubing, to avoid damage to the radiograph. Finally, the interior has a matt black finish to eliminate internal reflection.

This box, when used in conjunction with a horizontal viewing box under normal room light conditions, enables one to identify easily the cephalometric landmarks, even when tracing-paper is superimposed (*Fig.* 2). By excluding room light there is no reflection from the surface of the film, the radiograph being illuminated solely by transmitted light. The box also exerts a masking effect, thus intensifying one's view of the pertinent area. These two effects increase the apparent contrast of the radiograph and thereby clarify the cephalometric landmarks and soft tissue outlines.

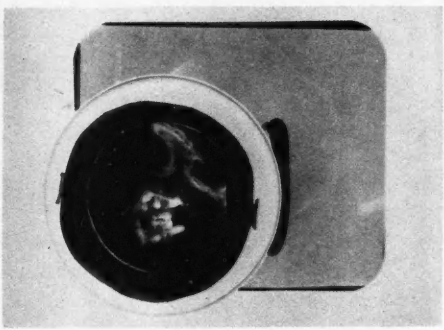

*Fig.* 2.—Note contrast between areas of radiograph inside and outside of tracing box.

**Acknowledgements.**—I am grateful to the Photographic Department for the photographs and to Mr. J. Roxby, Senior Dental Technician, Newcastle upon Tyne Dental Hospital, for his help in the construction of this tracing box.

A demonstration at the meeting held on May 9, 1960.

# VARIOUS TYPES OF EXTRA-ORAL ANCHORAGE APPLIANCES

By R. MARX, B.D.S., L.D.S., D.Orth. R.C.S.
*Royal Dental Hospital of London*

EXTRA-ORAL anchorage is nothing new to orthodontics. It was used as far back as 1822, and was described by Kneisel (1836), Gunnell (1842), C. Tomes (1873), Angle (1889), and others.

Extra-oral apparatus may be used to reinforce intra-oral anchorage, or as the sole means by which force is exerted to stimulate tooth movement.

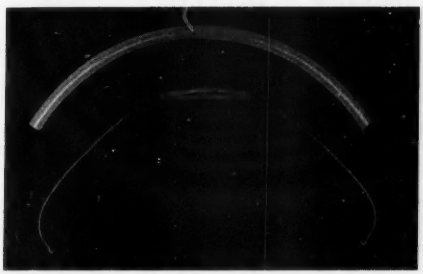

*Fig.* 1.—Cervical gear showing component parts.

The appliances shown were a selection of those that have been used in the past and some, including those illustrated photographically, are being used at present in the Orthodontic Department of the Royal Dental Hospital, London, and are described here.

They may be placed into three main groups: (1) Cervical; (2) Occipital; (3) Cervico-mental.

**1. Cervical.**—The apparatus being used at present consists of polyvinyl chloride non-toxic tubing (bore 7 mm., exterior diameter 11 mm., Shore hardness 82), inside which an elastic band connects two lengths of 1-mm. wire. The protruding ends of the wire are bent into hooks, which engage the labial bow of a removable or fixed intra-oral appliance (*Figs.* 1–4).

This apparatus may also be used in combination with a removable "cat's whisker" bow (*Fig.* 5). This gear is well tolerated by patients, and is easy to make. The disadvantage in its use is that the force exerted has a downward component which may be undesirable.

**2. Occipital.**—Two forms of headgear are in use at the moment:—

*a.* Plastic tape, 2 cm. wide, is used to construct the cap (*Fig.* 6) as described by McCallin (1954). A sagittal strap, not shown in the photograph, connects the coronal and horizontal straps. A hook on each side provides the attachment for elastic bands which are connected to a "cat's whisker" bow. The

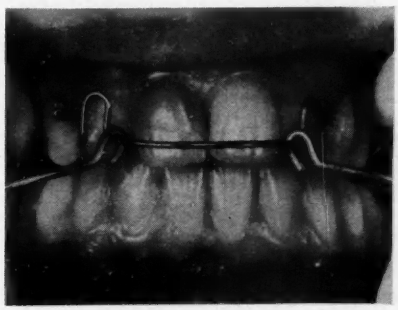

*Fig.* 2.—Method of attaching cervical gear directly to labial bow of removable appliance.

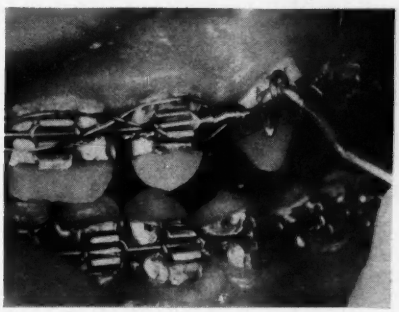

*Fig.* 3.—Method of attaching cervical gear directly to multiband fixed appliance.

A demonstration given at the meeting held on May 9, 1960.

advantage of this apparatus is its simplicity. It is comfortable to wear, does not shrink on washing, and requires no sewing or stapling. The hooks may be positioned so as to provide

**3. Cervico-mental.**—This apparatus consists of an acrylic chin cap made as described by Burnapp and Kettle (1955), used in conjunction with the cervical gear described

*Fig.* 4.—Patient wearing cervical gear.

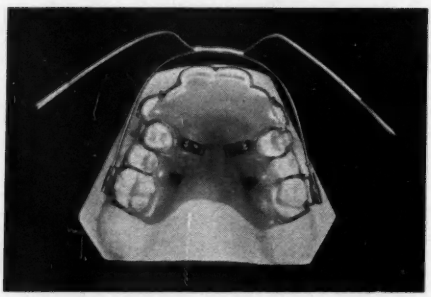

*Fig.* 5.—Removable appliance with "cat's whisker" bow slightly withdrawn from tubes on molar cribs to show stops. Extra-oral apparatus is here being used to reinforce anchorage.

traction in an upward and backward direction. This material, although not specifically non-toxic, has not produced any allergic skin reactions during years of use in this hospital.

*b.* Plastic tape is used in conjunction with polyvinyl chloride tubing, as described above. Traction can thus be directed along the occlusal plane or higher. This gear obviates the need for a "cat's whisker" bow (*Fig.* 7).

*Fig.* 6.—Plastic tape occipital head gear with "cat's whisker" bow.

above. Traction is applied to the chin cap by connecting the cervical gear to hooks embedded in the acrylic. Elastic bands pass from acrylic posts into the mouth, being

*Fig.* 7.—Head gear made of plastic tape and polyvinyl chloride tubing.

be used, as advocated by Oppenheim in a personal communication to Jerrold (1945), to act on the maxillary arch only, the force being so balanced as to avoid pressure against the lower labial segment. In the case illustrated (*Figs.* 8, 9) the apparatus is being used to move the maxillary buccal segments mesially.

*Fig.* 8.—To show elastic band passing back into the mouth from a post on the acrylic chin cap.

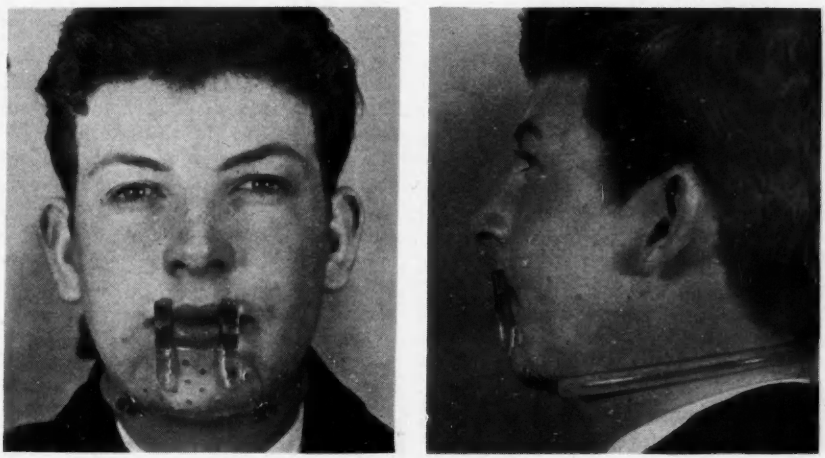

*Fig.* 9.—Cervico-mental apparatus on the patient.

attached to a removable or fixed maxillary appliance. The force exerted may be balanced so that pressure is applied by the chin cap against the lower labial segment via the lower lip, thus retroclining the lower incisors, while at the same time the maxillary arch is pulled forward. Alternatively, the apparatus may

**Acknowledgements.**—I wish to thank Mr. D. P. Walther, Director of the Orthodontic Department, Royal Dental Hospital, for his encouragement and advice; Mr. O. Krogstad, Sandfjord, Norway, for introducing me to the use of plastic tubing in orthodontics; and Mr. R. P. Palmer, Imperial Chemical

Industries, Plastics Division, for generously producing a sample of polyvinyl chloride non-toxic tubing. I am also indebted to members of the staff of the orthodontic laboratory and photographic department, Royal Dental Hospital, for their assistance in the preparation of exhibits, and to the Librarian, Royal Dental Hospital.

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**Transmission of Force to Bone**

The primary function of bone is to house and support soft tissues, and secondary functions are related to calcium and phosphorus metabolism and storage; to hæmopoiesis and to fat storage. The soft tissue immediately adjacent to the calcified portion of bone, the periosteum and endosteum, is essential for the maintenance and the addition or removal of the calcified material. This soft tissue would become anoxic if subjected for any length of time to a direct pressure higher than the local capillary blood-pressure.

Bone is subjected to intermittent and constant forces which are transmitted to the calcified material as direct pressure or as tension, or as a combination of these two. Perhaps the most important difference between an intermittent and a constant force is their effect on the blood-supply and thus on the metabolism of the periosteum or endosteum, bearing in mind that pressure can cause anoxia in these soft tissues. Within the limits of tolerance intermittent pressure on bone will be resisted and if increased within limits may lead to new bone formation, while a constant pressure which interferes with blood-supply will lead to resorption.

**Masticatory Forces.**—The periodontal membrane may be considered as a specialized periosteum which has to transmit the forces of mastication from the teeth to the bones. Loss of this function usually results in the complete disappearance of this membrane. The structure of the periodontal membrane and surrounding bone as well as the root-form are thought to be determined by the nature of the forces acting on the teeth which have to be transmitted to the bone. Thus the changes that occurred in function from the simple conical tooth-form of the homodont dentition to the complex crown-form of the primate dentition have gone hand in hand with changes in root-form, bone-form, and periodontal form.

The means by which forces applied to the teeth are transmitted through the periodontal membrane to the bone have not been established. Fluid pressure and the fibres of the periodontal membrane may play an active part in this process. The validity of the theory that the numerous vessels in the membrane act as hydraulic chambers from which fluid cannot rapidly escape when pressure is applied to the tooth is questioned, and the arrangement of the fibres of the periodontal membrane supports the alternative supposition that they serve to transmit the forces applied to the teeth to bone and yet prevent undue pressure on the rest of the contents of the membrane. The principal fibres are non-elastic and are not arranged in straight lines from bone to tooth. Limited movement of a tooth is permitted by the straightening of the fibres when a force is applied.

The transmission of force through a suture poses the problem that the periosteum-covered interdigitations of bone which join the bones increase the area of contact between the adjacent bones and so the pressure per unit area on the sutural periosteum will be reduced. The arrangement of the periosteal fibres in relation to these interdigitations could enable the periosteum to convert a pressure through a suture into a tension force on adjacent bones.—DREYER, C. F. (1960), *J. dent. Ass. S. Afr.*, **15**, 208.

G. E. B. MOORE